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PROCESS TO PREPARE A LUBRICATING BASE OIL

The invention is directed to a process to prepare a
base oil having a viscosity index of above 80 and a
saturates content of above 90 wt% from a crude derived
feedstock by means of a process comprising a
5   hydrocracking step and a catalytic dewaxing step.
EP-A-0909304 illustrates a process wherein a base oil
having a viscosity index (VI) of 95 is prepared from a
vacuum distillate boiling between 418 (5 wt% recovery)
and 564 °C (95 wt% recovery) by subjecting the feed to a
10   hydrocracking step using a catalyst based on Nickel and
Molybdenum. The high boiling part of the hydrocracker
effluent was subsequently dewaxed using a ZSM-5 based
dewaxing catalyst and hydrofinished using a
platinum/palladium based catalyst. The yield to base oil
15   was 62 wt%.
WO-A-0250213 describes a process to prepare a base
oil from the high boiling fraction of a fuels
hydrocracker process. In this process the high boiling
fraction is separated into different distillate fractions
20   . which are in turn subjected to a catalytic dewaxing step
and a hydrofinishing step.
US-A-5525209 describes a fuels hydrocracker process
wherein the bottoms fraction in which bottoms fraction
may potentially yield a base oil having a desired high
25   viscosity index value. It is shown in this publication
that the viscosity index of the base oil will increase at
higher conversion in the hydrocracker step.
According to general textbooks on base oil
manufacturing hydrocracking will reduce the viscosity of
the feedstock, remove most of the nitrogen, oxygen and
sulphur present in the base oil feedstock and convert the

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undesirable low VI materials such as polynuclear
aromatics and polynuclear naphthenes to higher VI
materials such as mononuclear aromatics, mononuclear
naphthenes and iso-paraffins (Chapter 6 and especially
page 122 of Lubricant Base Oil and Wax Processing,
Avilino Sequeira, Jr, Marcel Dekker Inc, New York, 1994,
ISBN 0-8247-9256-4).

A disadvantage of the above processes is that not all
crude derived feedstocks are suitable for preparing a
base oil having the desired VI. It may also be possible
that a crude derived feed is suitable to meet the VI
requirements of some but not all of the desired viscosity
grades. This could for example be due to the fact that
the content of polynuclear aromatics and naphthenics in
the relevant feed or feed fraction are too high. It may
sometimes be possible to meet the VI requirements by
increasing the hydrocracker conversion as explained
above. However such a higher conversion will
significantly lower the final base oil yield and may even
make it impossible to prepare the heavier grades.

EP-A-921184 describes a process wherein a Fischer-
Tropsch wax is added to a crude derived oil. This mixture
is used as feed to a hydrocracker. The effluent of the
hydrocracker is distilled and a bottom fraction is
recovered. This distiller bottom fraction is subjected to
a solvent dewaxing treatment to obtain a base oil having
a viscosity index of 145 or greater and a kinematic
viscosity at 100 °C of between 4.6 and 6.3 cSt.

According to EP-A-921184 the Fischer-Tropsch wax tobe
used in the disclosed process is isolated from the
Fischer-Tropsch synthesis product by only distillation.
Typically more than 80% by volume has a boiling point
higher than 550 °C. One such wax was exemplified and
because a substantially normal-paraffinic mixture is
expected for such a direct Fischer-Tropsch wax fraction a

congealing point of around 100 °C is estimated. This wax was mixed with a petroleum based waxy distillate having a final boiling point of 579 °C and the mixture was subjected to a hydrocracking step. From the examples it can be seen that when the Fischer-Tropsch wax containing feed was used a large fraction boiling above 635 °C was found in the effluent of the hydrocracker.

A disadvantage of the process according to EP-A-921184 is that a large portion of the valuable Fischer-Tropsch molecules added to the hydrocracker feed do not end up in the final base oils.

The object of the present invention is to provide a more efficient process to make base oils from a crude derived feedstock wherein use is made of a Fischer-Tropsch derived product in a more efficient manner. This object is achieved with the following process. Process to prepare a base oil having a viscosity index of above 80 and a saturates content of above 90 wt% from a crude derived feedstock by

(a) Contacting a crude derived feedstock in the presence of hydrogen with a catalyst comprising at least one Group VIB metal component and at least one non-noble Group VIII metal component supported on a refractory oxide carrier;

(b) Adding to the effluent of step (a) or part of the effluent of step (a) a Fischer-Tropsch derived fraction boiling at least partly in the base oil range in an amount effective to achieve the target viscosity index of the final base oil; and

(c) Dewaxing the mixture as obtained in step (b).

Applicants found that the use of Fischer-Tropsch fraction in the process according the invention greatly improves the flexibility of the process. Feedstocks derived from crudes which normally did not yield a base oil having the desired VI could now be used and/or the

yield of base oil as calculated on the petroleum derived feedstock could be improved. Applicants also found that base oils having a kinematic viscosity at 100 °C of greater than 7 cSt, preferably greater than 8 cSt having a viscosity index of greater than 80, preferably between 95 and 120 or even greater than 120 and preferably between 120 and 140 can be obtained in a good yield.

The petroleum derived feedstock as used in step (a) may be a vacuum distillate fraction as obtained from the residue of the atmospheric distillation of a crude petroleum feed. Such a fraction may be a vacuum gas oil or heavier fractions. The residue of the vacuum distillation itself may also be used. Suitably a vacuum residue is used which has been de-asphalted. Other possible feeds are for example the cycle oils as obtained in a fluid catalytic cracking process. Mixtures of the above feeds are of course also possible. If heavy base oil grades are preferred a feed is used wherein more than 10 wt%, preferably more than 20 wt% and most preferably more than 30 wt% of the compounds present in said feed boil above 470 °C. Suitably less than 60 wt% of the compounds present in the feed boil above 470 °C.

The feed to step (a) will typically have a low VI value of below 60 due to the presence of polynuclear aromatics and naphthenics. The VI of the feed as here defined is the VI of a solvent dewaxed sample having a pour point of -18 °C.

Step (a) may be performed according to well known hydrocracking processes. These processes may be both hydrocracking processes known to make primarily middle distillates and base oil hydrocracking processes. The conversion in step (a), expressed in the weight percentage of the fraction in the feed which boils above 370 °C which is converted to products boiling below 370 °C, in step (a) may thus range from values typical

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for base oil hydrocrackers and to values typical for fuels hydrocrackers. Such conversions may thus be between 20 and 80 wt%. The degree of conversion will depend on the feedstock quality as explained above and the availability of the Fischer-Tropsch derived blending fraction. A skilled person will be able to optimise the conversion given these parameters.

Step (a) may in addition also comprise a hydrotreating step performed prior to the actual hydrocracking step. In the hydrotreating step nitrogen and sulphur are removed and aromatics are saturated to naphthenes.. The reduction in sulphur and nitrogen is preferably such that the feed to step (c) is below 100 ppmw sulphur and more preferably below 50 ppm sulphur and more preferably below 10 ppmw nitrogen.

It has been found that in the process according to the present invention a base oil may be prepared having the desired VI wherein the conversion in the hydrotreating step is relatively low. This is especially advantageous when also more heavier grades are desired. The conversion is preferably below 40 and more preferably below 30 wt%. The preliminary hydrotreating step is typically performed using catalyst comprising a metal hydrogenation component, suitably a combination of a Group VIB and a non-noble Group VIII metal, for example cobalt-molybdenum, nickel-molybdenum, on a porous support, for example silica-alumina or alumina. The hydrotreating catalysts suitably contains no zeolite material or a very low content of less than 1 wt%. Examples of suitable hydrotreating catalysts are the commercial ICR 106, ICR 120 of Chevron Research and Technology Co.; 244, 411, DN-120, DN-180, DN-190 and DN-200, DN-3110, DN-3100 and DN-3120 of Criterion Catalyst Co.; TK-555 and TK-565 of Haldor Topsoe A/S; HC-k, HC-P, HC-R and HC-T of UOP; KF-742, KF-752, KF-846,

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KF-848 STARS and KF-849 of AKZO Nobel/Nippon Ketjen; and
HR-438/448 of Procatalyse SA.

The hydrotreating step is suitably performed at the
following conditions: temperature of at least 300 °C,
preferably from 350 to 450 °C and even more preferably from
370 to 430 °C. Operating pressure may range from 10 to
250 bar, but preferably is at least 80 bar, more preferably at
least 110 bar. In a particularly advantageous embodiment the
operating pressure is in the range of from 110 to 170 bar. The
weight hourly space velocity (WHSV) may range from 0.1 to
10 kg of oil per litre of catalyst per hour (kg/l.h) and
suitably is in the range from 0.2 to 5 kg/l.h.

The hydrocracking step may be any hydrocracking
process using well known hydrocracking catalysts or
variations of such catalysts having a
hydrogenation/dehydrogenation function on a suitable
support. Such a function is preferably a Group VIII/Group
VIB metal combination, for example nickel-molybdenum and
nickel-tungsten. The support is preferably a porous
support, for example silica-alumina and alumina. The
catalyst may also comprise an, optionally partly
dealuminated, large pore size zeolite. Examples of
suitable zeolites are zeolite X, Y, ZSM-3, ZSM-18, ZSM-20
and zeolite beta of which partly dealuminated zeolite Y
is most preferred. Examples of suitable hydrocracking
catalysts are the commercial ICR 220 and ICR 142 of
Chevron Research and Technology Co; Z-763, Z-863, Z-753,
Z-703, Z-803, Z-733, Z-723, Z-673, Z-603 and Z-623 of
Zeolist International; TK-931 of Haldor Topsoe A/S;
DHC-32, DHC-41, HC-24, HC-26, HC-34 and HC-43 of UOP;
KC2600/1, KC2602, KC2610, KC2702 and KC2710 of AKZO
Nobel/Nippon Ketjen; and HYC 642 and HYC 652 of
Procatalyse SA.

The hydrocracking step is suitably performed at the
following conditions: temperature of at least 300 °C,
preferably from 340 to 450 °C and even more preferably from

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350 to 430 °C. Operating pressure may range from 10 to
250 bar, but preferably is at least 80 bar, more preferably at
least 110 bar. In a particularly advantageous embodiment the
operating pressure is in the range of from 110 to 170 bar. The
weight hourly space velocity (WHSV) may range from 0.1 to
10 kg of oil per litre of catalyst per hour (kg/l.h) and
suitably is in the range from 0.2 to 5 kg/l.h.

In step (b) all or part of the effluent of step (a)
is mixed with the Fischer-Tropsch derived fraction.
Preferably only the fraction of said effluent boiling in
the base oil range is used in step (a). Suitably this
fraction has an initial boiling point higher than 300 °C
and more preferably higher than 340 °C. A maximum value
for the initial boiling point will depend on the desired
base oil grade one wishes to prepare.

The Fischer-Tropsch fraction may in principle be any
fraction which boils in the base oil range and which is
isolated from the synthesis product of the Fischer-
Tropsch reaction. More preferably a partly or whole
hydroisomerized Fischer-Tropsch wax is used. The use of
the isomerised product is preferred because a significant
part of the normal paraffins as present in a Fischer-
Tropsch synthesis product have then been isomerised to
the, for base oil manufacture, more desirable iso-
paraffins. The Fischer-Tropsch fraction preferably has a
boiling range, which corresponds with the petroleum
derived fraction as used in step (b).

The Fischer-Tropsch derived fraction may be obtained
by well-known processes, for example the so-called
commercial Sasol process, the Shell Middle Distillate
Process or by the non-commercial Exxon process. These and
other processes are for example described in more detail
in EP-A-776959, EP-A-668342, US-A-4943672, US-A-5059299,
WO-A-9934917 and WO-A-9920720. The process will generally
comprise a Fischer-Tropsch synthesis and a hydro-
isomerisation step as described in these publications.

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Preferably the fraction will comprise of a substantial
amount of compounds boiling in the base oil range. The
fraction preferably has a relatively low pour point,
which is beneficial when the Fischer-Tropsch fraction has
to be transported from remote locations to the base oil
process facility. For this reason the Fischer-Tropsch
fraction has been partly isomerised. More preferably the
Fischer-Tropsch fraction may be partly isomerised to
substantially totally isomerised. Preferably the content
of normal paraffins in the partly isomerised fraction is
between 4 and 20 wt%, more preferably between 5 and 15
wt%. A preferred partly isomerised Fischer-Tropsch
fraction will boil for more than 90 wt% above 300 °C and
more preferably above 340 °C. The T90wt% recovery point
is preferably above 500 °C and more preferably between
500 and 650 °C. The fraction will preferably have a
congealing point below 80 °C, more preferably below 60 °C
and even more preferably below 50 °C. The wax content of
this partly isomerised Fischer-Tropsch fraction is
preferably below 50 wt%, more preferably below 30 wt%.
The lower wax content of such a fraction is suitably
above 1 wt% wax, preferably above 5 wt% wax and more
preferably above 10 wt% wax. The wax content is
determined by separating the wax component at -27 °C by
means of solvent dewaxing using a 50/50 (vol/vol)
MEK/Toluene solvent. Distillate fractions of the above
described partly isomerised Fischer-Tropsch fraction may
also be used in the process of the present invention when
one seeks to improve only the properties of a specific
base oil grade as also explained below. An example of a
suitable partly isomerised fraction is the so-called
Shell MDS Waxy Raffinate as obtainable from Shell MDS
(Malaysia) Sdn Bhd or the product as described in WO-A-
02070630 or fractions of said products. Partly isomerised

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Fischer-Tropsch feeds may be used in processes involving both solvent and catalytic dewaxing.

As described above, the isomerised Fischer-Tropsch fraction may be substantially totally isomerised. The degree of total isomerisation is expressed in its pour point, which is for such a totally isomerised fraction below -10 °C and suitably below -15 °C. These oils may be obtained by dewaxing the above-described partly isomerised Fischer-Tropsch fraction or by performing the hydroisomerisation step at a high conversion, suitably above 50 wt% per pass, preferably above 60 wt% on a preferably heavy Fischer-Tropsch wax feed having a weight ratio of compounds having more than 60 carbon atoms relative to compounds having more than 30 carbon atoms of above 0.4, preferably above 0.55. The conversion is defined as the compounds boiling above 370 °C in the feed that are converted to compounds boiling below 370 °C. These totally isomerised fractions may be considered to be suitable to be used as base oils themselves. However they contain for some uses a too high content of paraffins, which paraffins influences the solvency for additives in a negative manner. By using a blend of this isomerised Fischer-Tropsch fraction in step (b) it is possible to prepare a base oil in step (c) which will have the desired level of paraffins at exactly the right pour point of the end product. If the dewaxed oil is fractionated to separate light components and optionally isolate more than one base oil grade a base oil product is obtained having also just the right Noack volatility and viscosity. This would not be achieved in such a simple manner if the totally isomerised Fischer-Tropsch fraction was to be added to a finished base oil because properties like viscosity, volatility and pour point would in most cases not match such to obtain exactly the desired base oil product.

The totally isomerised Fischer-Tropsch fraction will preferably boil for more than 90 wt% above 300 °C and more preferably above 340 °C. The T90wt% recovery point is preferably above 500 °C and more preferably between 500 and 650 °C. Distillate fractions of this totally isomerised Fischer-Tropsch fraction may also be used in the process of the present invention when one seeks to improve only the properties of a specific base oil grade as also explained below.

Alternatively, but less preferred than the partly or totally isomerised Fischer-Tropsch products, one may use as the Fischer-Tropsch fraction the n-paraffin waxes as obtainable from said Fischer-Tropsch processes having preferably a congealing point of between 20 and 80 °C. Examples are SX-30, SX-50 and SX-70 as obtainable from Shell MDS (Malaysia) Sdn Bhd. If such waxes are used a catalytic dewaxing in step (c) is preferred, more preferably a dewaxing catalyst is used having a high ability to isomerise the normal paraffins. See for preferred catalysts below. Of course fractions having similar properties as described above as obtainable from other processes may also be advantageously used in our invention.

The mixture as obtained in step (b) will suitably have a viscosity corresponding to the desired viscosity of the base oil product. Preferably the kinematic viscosity at 100 °C of the mixture is between 3 and 10 cSt. The content of Fischer-Tropsch derived fraction in the mixture is preferably higher than 5 wt%, more preferably higher than 10 wt% and preferably lower than 50 wt% and more preferably below 30 wt% and even more preferably below 25 wt%.

With the dewaxing in step (c) is understood every process wherein the pour point of the base oil is reduced by more than 10 °C, preferably more than 20 °C, more

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preferably more than 25 °C. The dewaxing can be performed
by means of a so-called solvent dewaxing process or by
means of a catalytic dewaxing process. Solvent dewaxing
is well known to those skilled in the art and involves
admixture of one or more solvents and/or wax
precipitating agents with the base oil precursor fraction
and cooling the mixture to a temperature in the range of
from -10 °C to -40 °C, preferably in the range of from -
20 °C to -35 °C, to separate the wax from the oil. The
oil containing the wax is usually filtered through a
filter cloth which can be made of textile fibres, such as
cotton; porous metal cloth; or cloth made of synthetic
materials. Examples of solvents which may be employed in
the solvent dewaxing process are C_3-C_6 ketones (e.g.
methyl ethyl ketone, methyl isobutyl ketone and mixtures
thereof), C_6-C_{10} aromatic hydrocarbons (e.g. toluene),
mixtures of ketones and aromatics (e.g. methyl ethyl
ketone and toluene), autorefrigerative solvents such as
liquefied, normally gaseous C_2-C_4 hydrocarbons such as
propane, propylene, butane, butylene and mixtures
thereof. Mixtures of methyl ethyl ketone and toluene or
methyl ethyl ketone and methyl isobutyl ketone are
generally preferred. Examples of these and other suitable
solvent dewaxing processes are described in Lubricant
Base Oil and Wax Processing, Avilino Sequeira, Jr, Marcel
Dekker Inc., New York, 1994, Chapter 7.

Preferably step (c) is performed by means of a
catalytic dewaxing process. The catalytic dewaxing
step (c) can be performed by any process wherein in the
presence of a catalyst and hydrogen the pour point of the
base oil precursor fraction is reduced as specified
above. Suitable dewaxing catalysts are heterogeneous
catalysts comprising a molecular sieve and optionally in
combination with a metal having a hydrogenation function,
such as the Group VIII metals. Molecular sieves, and more

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suitably intermediate pore size zeolites, have shown a
good catalytic ability to reduce the pour point of the
distillate base oil precursor fraction under catalytic
dewaxing conditions. Preferably the intermediate pore
size zeolites have a pore diameter of between 0.35 and
0.8 nm. Suitable intermediate pore size zeolites are
mordenite, ZSM-5, ZSM-12, ZSM-22, ZSM-23, SSZ-32, ZSM-35
and ZSM-48. Catalysts having a high ability to isomerise
normal paraffins will preferably comprise ZSM-12, ZSM-22,
ZSM-23 or SSZ-32. Another preferred group of molecular
sieves are the silica-aluminaphosphate (SAPO) materials
of which SAPO-11 is most preferred as for example
described in US-A-4859311. ZSM-5 may optionally be used
in its HZSM-5 form in the absence of any Group VIII
metal. The other molecular sieves are preferably used in
combination with an added Group VIII metal. Suitable
Group VIII metals are nickel, cobalt, platinum and
palladium. Examples of possible combinations are
Ni/ZSM-5, Pt/ZSM-23, Pd/ZSM-23, Pt/ZSM-48 and Pt/SAPO-11.
Further details and examples of suitable molecular sieves
and dewaxing conditions are for example described in
WO-A-9718278, US-A-5053373, US-A-5252527, US-A-4574043,
WO-A-2004033594 and WO-A-2004033593.

    The dewaxing catalyst suitably also comprises a
binder. The binder can be a synthetic or naturally
occurring (inorganic) substance, for example clay, silica
and/or metal oxides. Natural occurring clays are for
example of the montmorillonite and kaolin families. The
binder is preferably a porous binder material, for
example a refractory oxide of which examples are:
alumina, silica-alumina, silica-magnesia, silica-
zirconia, silica-thoria, silica-beryllia, silica-titania
as well as ternary compositions for example silica-
alumina-thoria, silica-alumina-zirconia, silica-alumina-
magnesia and silica-magnesia-zirconia. More preferably a

low acidity refractory oxide binder material, which is
essentially free of alumina, is used. Examples of these
binder materials are silica, zirconia, titanium dioxide,
germanium dioxide, boria and mixtures of two or more of
these of which examples are listed above. The most
preferred binder is silica.

A preferred class of dewaxing catalysts comprise
intermediate zeolite crystallites as described above and
a low acidity refractory oxide binder material which is
essentially free of alumina as described above, wherein
the surface of the aluminosilicate zeolite crystallites
has been modified by subjecting the aluminosilicate
zeolite crystallites to a surface dealumination
treatment. A preferred dealumination treatment is by
contacting an extrudate of the binder and the zeolite
with an aqueous solution of a fluorosilicate salt as
described in for example US-A-5157191 or WO-A-2000029511.
Examples of suitable dewaxing catalysts as described
above are silica bound and dealuminated Pt/ZSM-5, silica
bound and dealuminated Pt/ZSM-23, silica bound and
dealuminated Pt/ZSM-12, silica bound and dealuminated
Pt/ZSM-22 as for example described in WO-A-200029511 and
EP-B-832171.

Catalytic dewaxing conditions are known in the art
and typically involve operating temperatures in the range
of from 200 to 500 °C, suitably from 250 to 400 °C,
hydrogen pressures in the range of from 10 to 200 bar,
preferably from 40 to 170 bar, weight hourly space
velocities (WHSV) in the range of from 0.1 to 10 kg of
oil per litre of catalyst per hour (kg/l/hr), suitably
from 0.2 to 5 kg/l/hr, more suitably from 0.5 to
3 kg/l/hr and hydrogen to oil ratios in the range of from
100 to 2,000 litres of hydrogen per litre of oil. By
varying the temperature between 315 and 375 °C at between
40-70 bars, in the catalytic dewaxing step it is possible

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to prepare base oils having different pour point specifications varying from suitably lower than -60 to -10 °C.

If the feed to a catalytic dewaxing step (c) has a relatively high nitrogen content of above 10 ppm a pre-treat step is preferably performed wherein under hydroconversion conditions similar to the dewaxing conditions the feed to step (c) is contacted with a noble metal catalyst. Examples of suitable noble metal catalysts are the palladium/platinum containing catalysts C-624 and C-654 of Criterion Catalyst Company. After such a treatment the nitrogen content is reduced to below 10 ppm that is advantageous for the performance of the dewaxing catalyst downstream said treatment.

After performing the pour point reducing treatment lower boiling compounds formed during said treatment are suitably removed, preferably by means of distillation, optionally in combination with an initial flashing step.

The effluent of the pour point reducing treatment may suitably be subjected to a hydrogenation treatment step (d). Hydrogenation may be performed on the entire effluent or on specific base oil grades after the above-described fractionation. This may be required in order to increase the content of saturate compounds to values above 90 wt% more preferably above 95 wt%. Such a hydrogenation is also referred to as a hydrofinishing step. This step is suitably carried out at a temperature between 180 and 380 °C, a total pressure of between 10 to 250 bar and preferably above 100 bar and more preferably between 120 and 250 bar. The WHSV (Weight hourly space velocity) ranges from 0.3 to 2 kg of oil per litre of catalyst per hour (kg/l.h). Optionally the hydrogenation is performed in the same reactor as the catalytic dewaxing reactor. In such a reactor the beds of dewaxing

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catalyst and hydrogenation catalyst will be placed in a
stacked bed on top of each other.

The hydrogenation catalyst is suitably a supported
catalyst comprising a dispersed Group VIII metal.
Possible Group VIII metals are cobalt, nickel, palladium
and platinum. Cobalt and nickel containing catalysts may
also comprise a Group VIB metal, suitably molybdenum and
tungsten. Suitable carrier or support materials are low
acidity amorphous refractory oxides. Examples of suitable
amorphous refractory oxides include inorganic oxides,
such as alumina, silica, titania, zirconia, boria,
silica-alumina, fluorided alumina, fluorided silica-
alumina and mixtures of two or more of these.

Examples of suitable hydrogenation catalysts are
nickel-molybdenum containing catalyst such as KF-847 and
KF-8010 (AKZO Nobel) M-8-24 and M-8-25 (BASF), and C-424,
DN-190, HDS-3 and HDS-4 (Criterion); nickel-tungsten
containing catalysts such as NI-4342 and NI-4352
(Engelhard) and C-454 (Criterion); cobalt-molybdenum
containing catalysts such as KF-330 (AKZO-Nobel), HDS-22
(Criterion) and HPC-601 (Engelhard). Preferably platinum
containing and more preferably platinum and palladium
containing catalysts are used. Preferred supports for
these palladium and/or platinum containing catalysts are
amorphous silica-alumina. Examples of suitable silica-
alumina carriers are disclosed in WO-A-9410263. A
preferred catalyst comprises an alloy of palladium and
platinum preferably supported on an amorphous silica-
alumina carrier of which the commercially available
catalyst C-624 of Criterion Catalyst Company (Houston,
TX) is an example.

With the process according to the present invention
different base oil grades may be prepared, such as
spindle oil, light machine oil and medium machine oil
having a saturates content of above 90 wt%, more

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preferably higher than 95 wt%. In the context of the
present invention terms as spindle oil, light machine oil
and medium machine oil will refer to base oil grades
having an increasing kinematic viscosity at 100 °C and
wherein the spindle oil additionally has a maximum
volatility specification. Preferably a spindle oil is a
light base oil product having a kinematic viscosity at
100 °C of below 5.5 cSt and preferably above 3.5. The
spindle oil can have either a Noack volatility, as
determined by the CEC L-40-T87 method, of preferably
below 20% and more preferably below 18% or a flash point,
as measured according to ASTM D93, of above 180 °C.
Preferably the light machine oil has a kinematic
viscosity at 100 °C of below 9 cSt and preferably above
6.5 cSt and more preferably between 8 and 9 cSt.
Preferably the medium machine oil has a kinematic
viscosity at 100 °C of below 13 cSt and preferably above
10 cSt and more preferably between 11 and 12.5 cSt. The
corresponding base oil grade can have a viscosity index
of between 95 and 120.

The above referred to base oils are typically API
Group II base oils having a viscosity index of between 80
and 120. With the present invention it is also possible
to prepare so-called API Group III base oils having a
viscosity index of above 120 and preferably up to 140 by
for example adding more of the Fischer-Tropsch derived
fraction in step (b), adjusting the process conditions in
step (a) or by using a crude derived feedstock which in
itself yields a higher VI base oil. In the context of the
present invention the content of the Fischer-Tropsch
derived fraction in the mixture obtained in step (b) is
less than 60 wt%, preferably less than 50 wt%.

The above base oil grades may be obtained by
distilling the product as obtained after step (c) or
step (d). In some base oil processing units comprising

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hydrocracking and catalytic dewaxing these base oil
grades are prepared one at a time in a so-called blocked
out mode as for example described by Figure 1.1 on page 2
of the above referred to General Textbook of Avilino
Sequeira Jr. Another option is that a full range feed is
processed in step (a) and that from the effluent of
step (a) fractions are isolated which correspond to the
above spindle, light and medium machine oil grade as for
example described in the above referred to WO-A-0250213.
The individual grades are subsequently further processed
in step (c) in a blocked out mode. In terms of the
present invention one or more of these grades can be
mixed with the Fischer-Tropsch fraction. When processing
the different grades separately through steps (a) and/or
(c) it is possible to use the Fischer-Tropsch fraction to
correct only for those grades which need correction in
VI. In a prior art process without having this
possibility it was not possible to target the desired VI
for every grade. In practice one would target the VI for
the most difficult grade and accept a VI much higher than
the specification for the remaining grades. As explained
above a too high VI implicates a non-optimal yield for
the base oil. This quality give-away can now be avoided
with the process according to the present process.

The invention will be illustrated by the following non-
limiting examples.

Example 1

In Example 1 a blend of two components have been
catalytically dewaxed. The first component was an
intermediate product having the properties as listed in
Table 1. This intermediate product was prepared by
contacting a vacuum distillate feed first with a NiMo on
alumina type hydrotreating catalyst(s) followed by

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contacting the hydrotreated fraction with a hydrocracking
catalyst consisting of NiW on an alumina carrier wherein
the hydrocracking catalyst contained 50 wt% zeolite Y.
These two steps were performed at 150 bars hydrogen
5   pressure. From the effluent middle distillates and lower
boiling fractions were separated from the higher boiling
intermediate product by means of distillation.

    The second component was a partly isomerised Fischer-
Tropsch derived fraction obtained from Shell MDS
10   (Malaysia) Sdn Bhd marketed as Shell MDS Waxy Raffinate.

Table 1

Component		Intermediate product as made from a vacuum distillate of a crude mineral source	Shell MDS Waxy Raffinate as obtained from Shell MDS (Malaysia) Sdn Bhd
Example		Example 1	Example 1
Content in blend	Wt%	50	50
Vk@100°C	cSt	4.982	5.181
Refractive index		1.457	
Density		824.2	784.3
Wax melting point	°C		+47
IBP %m distilled	°C	197	347
10	"	350	396
50	"	437	461
70	"	474	490
90	"	527	529
FBP	"	602	592
Wax content(*)	Wt%	20	21.4

5   (*) as determined after separating the wax component at -27 °C by means of solvent dewaxing.

The above blend, analysed for sulphur (44 ppm) and nitrogen (2 ppm), was contacted with a dewaxing catalyst
10   consisting of 0.7 wt% platinum, 25 wt% ZSM-12 and a silica binder. The dewaxing conditions were 140 bar

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hydrogen, WHSV = 1 kg/l.h, and a hydrogen gas rate of
750 Nl/kg feed. The experiment was carried out at three
different reaction temperatures: 339, 343 and 345 °C.

The dewaxed effluent was cut at 470 °C and the 470 °C
plus fraction was analysed. The properties of the 470 °C
plus fraction are listed in Table 2. Higher viscosity
grades could have been obtained at cutting the
dewaxed oil at a higher temperature than the now
exemplified 470 °C.

Table 2

Example	1a	1b	1c
Reactor temperature	339	343	345
Yield on feed of 470 °C+ fraction (wt%)	29.5	26.4	25.3
470°C+ Pour Point (°C)	- 14	- 20	- 28
Viscosity Index of the 470°C+ fraction	130.1	127.4	124.3
Kinematic viscosity at 100 °C (cSt)	8.582	8.809	9.077

Comparative Experiment A

Example 1 was repeated except that the feed was 100%
of the intermediate product as made from a vacuum
distillate of a crude mineral source as listed in
Table 1.

The reactor temperatures were again varied as listed
in Table 3. The properties of the 470 °C plus fraction
were analysed and reported in Table 3.

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Table 3

Experiment		A-1	A-2	A-3
Reactor temperature	°C	336	341	346
Pour point	°C	-11	-23	-35
Viscosity index	-	103	100	94
Kinematic viscosity at 100 °C	cSt	11,51	11,77	12,89